newly hatched young were fed grasshopers, the skinks being fed to chicks more than a few days old. At this age the chicks leave the nest and shuffle off resting under the shade of the samphire bushes, always in company of one or both of the adults. The young swam freely yet adult birds rarely land on the water. The terns flew out at first light from the nesting colonies to fly ceaselessly over the mulga scrub in search of food. Upon locating their prey the birds swoop down hardly altering their flight, seize the prey and proceed back to the nest site. At no time did the birds make any attempt to procure food from the waters of the lake, in contrast to a group of 200 Marsh Terns that fed continuously over the water. Occasionally the birds would swoop down to scoop up a drink of water.

All nesting birds were in full breeding plumage, although an occasional bird in juvenile plumage was seen in the vicinity. No predation of the young was observed although a Spotted Harrier was seen for twenty minutes flying near the colonies continuously being harrassed by many terns. The birds defended their territories by holding their heads high, bill open exposing their bright orange gape and screaming at intruders. In general the birds often sat quietly together at the nest.

Lake Annean is a remarkable lake where in good seasons a great variety of birds gather together to breed on the many small islands. Hoary-headed Grebes were nesting everywhere; most nests contained eggs. The nests were built in samphire bushes, although many were lying high and dry where the receding water had stranded them. It was quite impossible to count the nests as many were neglected, and eggs were everywhere; many washed up on the beaches.

Pied Stilts were scattered over most of the islands, some brooding eggs, but most still building. Two pairs with four large chicks were observed foraging around the shores of the lake.

A small colony of ten or so had built their bulky nests on a small exposed island when we first visited, some had eggs, however when we returned a week later the eggs were gone and the colony deserted. Some 500 m away they were building again, this time on samphire bushes growing in about 15 cm of water, and laying had just commenced.

One or two pairs of Red-kneed Dotterel occupied each island, with breeding commencing.

John Masters visited Lake Wooleen about 250 km west of Lake Annean on 20 September 1980 where he found another colony of the Terns nesting. At the time of his visit the water level of the lake was high and little of the islets was exposed. Approximately 200 birds were present of which thirty pairs were nesting on an exposed low sandy island. The general behaviour of the other birds suggested that as more land became exposed they too would breed.

A small colony of Straw-necked Ibis were nesting on the ground alongside the Terns.

THE DISTRIBUTION OF THE SEA ANEMONE *ACTINIA TENEBROSA* FARQUHAR IN SOUTHWESTERN AUSTRALIA

By D.J. AYRE, Department of Zoology, University of Western Australia, Nedlands, W.A. 6009

INTRODUCTION

The sea anemone *Actinia tenebrosa* Farquhar 1898 is widely distributed on Australian and New Zealand coasts and occurs on rocky shores in the intertidal zone (Ottaway, 1973; 1979a). In Western Australia this species is recorded from the mainland coast near Fremantle and 20km west at Rottnest Island (32° S; 115° 30'E) (Carlgren, 1954; Black and Johnson, 1979; Ayre, 1982) and at the mouth of the Murchison River (Carlgren 1954) but its distribution is otherwise poorly documented.

Recent studies have shown that *A. tenebrosa* may utilize two mechanisms of reproduction and dispersal (Ottaway and Kirby, 1975; Ottaway, 1979b; Black and Johnson, 1979; Ayre, 1982; in press). Asexually produced juveniles are brooded within the coelenterons of a genotypically identical adult (Black and Johnson, 1979), and on release these juveniles attach to the substrate in close proximity to their broodparent (Ottaway, 1979b; Ayre, in press). Genetic

studies have confirmed that the majority of recruits within established populations are the asexual progeny of nearby adults (Black and Johnson, 1979; Ayre, in press). In addition, there is strong indirect evidence that *A. tenebrosa* reproduces sexually, producing widely dispersed planktonic larvae (Black and Johnson, 1979; Ayre, in press).

I have attempted to document the distribution of *A. tenebrosa* on the southwestern coast of Western Australia and so test the possibility that this species is a successful colonist of isolated areas of shore. Man made structures such as breakwaters were also examined to determine the rate of colonisation of new areas of shore.

The Fremantle Region and Rottnest Island;
A. tenebrosa is locally abundant on the limestone shores of the islands and mainland coast within 60km of Fremantle. Most areas of rocky shore between Mandurah (53km south) and Lancelin (119km north) were searched intensively during the period March 1980 to September 1982. Populations of *A. tenebrosa* (estimated adult number) were found at Cape Peron (500), Woodman Point (4000), The North Mole of Fremantle Harbour (2000), Cottesloe Beach (500), Triggs Beach (200), Burns Beach (500) and Two Rocks (1000). Extremely dense populations comprising many thousands of adults are present on the larger islands of Shoalwater Bay and Warnbro Sound (30 to 35km south). These islands include Bird Island, Seal Island, Shag Rock and Penguin Island. Other islands in this chain were not visited but several should be expected to support *A. tenebrosa* populations. An intensive search of all areas of rocky shore on Rottnest Island conducted during March and April 1980 revealed 19 separate populations (Fig. 1). In addition a single adult was recorded at North Point in 1978 (M.S. Johnson personal communication).

All populations were situated on west or south-west facing areas of shore which provided shelter from desiccation and wave action and were not subject to burial or scouring by sand.

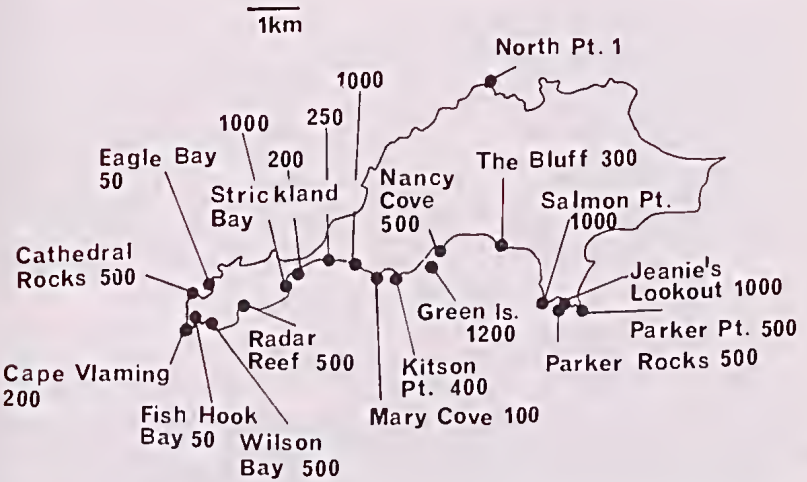

Figure 1. The locations and sizes of *Actinia tenebrosa* populations (estimated adult numbers) on Rottnest Island.

Remote Populations;
An additional 18 populations were found on rocky shore between Kalbarri and Cape Le Grande (Fig. 2). Populations were present on both limestone and granite shores although no populations with more than an estimated 250 adults were found on granite. The shore between Nanarup and Observatory Point and between Lancelin and Jurien Bay was not searched.

The shore between Mandurah and Nanarup was visited in December 1981. All areas of rocky shore, accessible by 2 wheel drive vehicle, were searched intensively with the exception of the limestone and granite areas between The Gap and The Cheyne Beach Whaling Station (south of Albany) and the

limestone cliff area north of Windy Harbour. A small population was recorded at the southern end of the cliffs near Windy Harbour and additional populations are almost certainly present in that area. The Cape Le Grande and Thistle Cove populations were recorded by M.S. Johnson in January 1982.

Only 2 populations were found on the 230km of coast between Jurien Bay and Kalbarri. All areas accessible by 4-wheel drive vehicle were searched during September 1982, however most of the rocky shore in this area is either severely exposed or subject to scouring by sand.

In many areas, offshore islands appeared likely sites for *A. tenebrosa* populations but I did not attempt to visit any of these. The Bald Island population was recorded by D. King in May 1982.

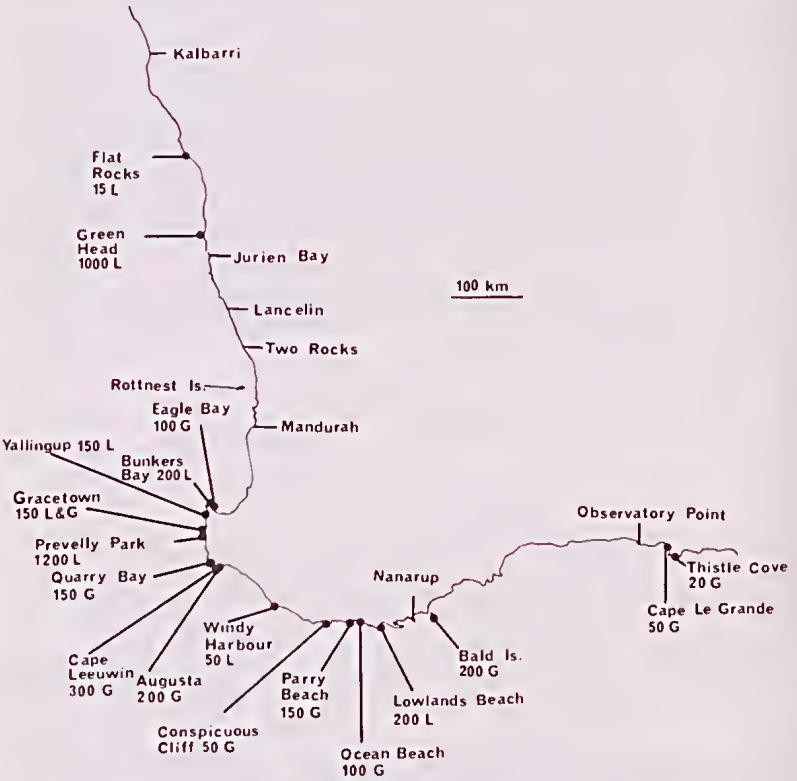

Figure 2. The locations of 18 *Actinia tenebrosa* populations in south western Australia. Estimated adult numbers and rock substrates (L = limestone, G = granite) are given. The areas between Jurien Bay and Lancelin and between Nananup and Observatory Point were not searched. The locations of additional populations on the mainland shore and islands between Two Rocks and Mandurah are described in the text and Fig. 1.

Man-made Rocky Shore;

A. tenebrosa populations were found on limestone boulders on the North Mole of Fremantle Harbour and on the Woodman Point and Wapet Groyne breakwaters. The North Mole population is concentrated near the original shoreline and may be an extension of a pre-existing population. Only one small additional area (500m west) has been colonised, and supports a population of approximately 200 adults, although several hundred metres of similar shore is available. Similarly the Woodman Point population is continuous with an extensive population on the natural limestone shore and almost certainly represents a simple expansion of the pre-existing population and Wapet Groyne is only 500m from this population. A 22 year old limestone

breakwater at Cottesloe and a 10 year old marina at Two Rocks are both within 100m of established populations but no *A. tenebrosa* colonists were detected on these structures. The following breakwaters and marinas were also examined: Bunbury (southern breakwater), City Beach (2 groynes), Cottesloe (southern breakwater), Dongarra Marina, Fremantle Fishing Boat Harbour, Garden Island Causeway (partially checked), Geraldton Marina, Ocean Reef Marina, Powerhouse Jetty (Spearwood), Rottnest Jetty, South Mole (Fremantle), Success Harbour (Fremantle), Two Rocks Marina, Woodman Point Groyne (1½km SE Woodman Point) and Yanchep Groyne. No *A. tenebrosa* were found on these structures although many support a range of other intertidal species.

DISCUSSION

A. tenebrosa was found on all natural rocky shores, irrespective of their degree of isolation from other populations, which provided shelter from desiccation and wave action and were not subject to scouring by sand. Some of these populations (e.g. Flat Rocks and Thistle Cove) are restricted to very small areas of shore and such populations must be subject to periodic extinction and colonisation. The distribution of *A. tenebrosa* on the coast of Southwestern Australia is thus consistent with Black and Johnson's (1979) prediction that *A. tenebrosa* produces, at least occasionally, non-brooded planktonic offspring. Black and Johnson (1979) hypothesised that planktonically dispersed juveniles should be sexually produced and this is also strongly supported by genetic evidence (Black and Johnson, 1979; Ayre, in press). The absence of *A. tenebrosa* from most areas of man made rocky shore, including two areas close to natural populations, implies that colonisation over distances as short as 100m is rare, and that existing populations are probably very old. *A. tenebrosa* was not found on areas of man made shore that were clearly separate from natural populations, with the possible exception of the 90 year old North Mole. However, the existence of the North Mole and Woodman Point populations demonstrates that such shore can support this species.

Since *A. tenebrosa* adults are potentially very long lived (Ottaway, 1980) and populations are extremely stable (Ottaway, 1978; 1979b), a combined strategy of localised proliferation of established colonists and rare planktonic colonisation episodes could maintain the existing distribution of this species. Similar temporally variable patterns of settlement and recruitment are known for other marine invertebrates (Underwood, 1979). It is likely that most of the large populations of *A. tenebrosa* could survive relatively major environmental disturbances since specimens are spread through a number of micro habitats, such as pools, crevices and the undersides of boulders. Recolonisation of these populations would be expected to occur relatively rapidly through the expansion of surviving clones. However, small populations confined to single habitat types should be more vulnerable and less genetically diverse.

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THE SURVIVAL, HABITAT AND A NEW RECORD FOR THE SCORPION *CERCOPHONIUS SQUAMA* (SCORPIONIDA : BOTHRIURIDAE)

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The scorpion, *Cercophonius squama* (Gervais), is generally distributed in the cooler, wetter areas of southern Australia, but is also found in some of the warmer, drier parts of north-western Victoria, Western Australia and at Alice Springs in the Northern Territory (localities listed in Koch, 1977).

In July 1981 I found two specimens of *C. squame* under rocks at Maggie Springs, about 50 metres from the base of the south side of Ayers Rock. One scorpion was eating a centipede and the other an ant. The area was covered with sparse bloodwoods (*Eucalyptus terminalis*) over dense perennial grass (*Themeda avenacea*). Both scorpions were found on the edge of this vegetation where the grass clumps were more scattered and where there were a number of rocks between the grass clumps.

Koch (1977) considers that the ancestor species of *C. squama* may have been widespread throughout Australia in the early tertiary, and that changes since then have resulted in *Cercophonius* contracting its distribution southwards, leaving relict populations in the Northern Territory and outlier populations in some of the more arid areas of Western Australia, South Australia and Victoria.

The presence of a predominately temperate species in central Australia and other semi-arid areas may appear anomalous. However, if the microhabitat and behaviour of the species is considered, its presence in these areas is understandable.

Maggie Springs is a permanent spring, situated on the steep south face of Ayers Rock. Although no climatic data are available for the area, it is reasonable to assume that the temperature will be considerably lower and the soil moisture higher than in other locations in the area. Assuming that the microclimate is milder, the burrowing habit of the species will further enhance its ability to survive in an otherwise inhospitable area. Specimens of *C. squama* from the A.C.T., Albany in W.A. and Ayers Rock have been observed to burrow in captivity, where they dig a shallow burrow each night, sometimes closing the entrance to the burrow, and digging a new exit the following night. After feeding, some individuals have remained in their sealed burrows for up to four months. Clearly, this ability would enable the species to sit out the harsh summer months.

The survival of *C. squama* in semi-arid regions can be attributed to the presence of a suitable microhabitat, its ability to burrow and the general ability of scorpions to survive for months without food.

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